CoIRICH

Neutron investigations

RESEARCH ACTIVITY

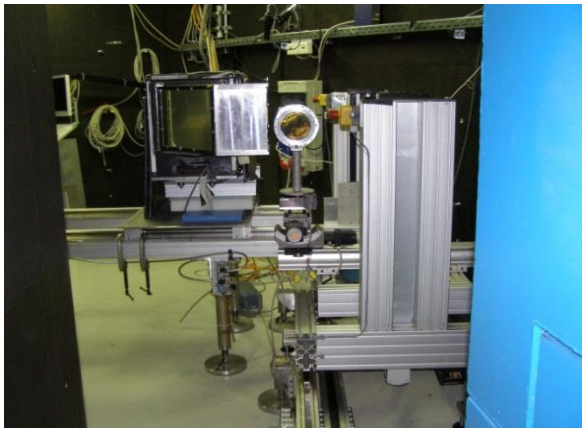
- Structural study of cultural heritage materials through neutron experimental techniques such as diffraction, radiography, tomography, *Prompt-Gamma-Activation Analysis (PGAA) Neutron Resonance Capture* Imaging (NRCA), etc.
- Research and Development of new instrumentation in the field of neutrons and *imaging* applied to cultural heritage.

RESEARCH GROUP

Università degli Studi Tor Vergata e Centro NAST

Carla Andreani
Giulia Festa
Roberto Senesi
Matteo Nardini
Davide Flammini

Non-invasive and non-destructive techniques



GILDED BRONZE RELIEF COMING FROM EAST DOOR OF FLORENCE BAPTISTERY DURING MEASUREMENTS PERFORMED AT NEUTRON SOURCES (ISIS – ENGLAND AND FRMII - GERMANY)

RESULTS/PRODUCTS

Study of bronze reliefs coming from 'Paradise Doors' of the Florence Baptistery to verify the gilding conservation state, the extension of secondary fusion in terms of composition and type of working methods.

APPLICATIONS

- Gilded bronze reliefs of Florence Baptistery
- Villa Adriana marbles (Tivoli, Rome)
- Etruscan bronzes and ceramics (Villa Giulia, Museo Civico Milano)
- Roman ceramics and coins preserved in Italian museums (sicily, etc).
- Metallical musical instruments (Accademia Nazionale S. Cecilia)

CoIRICH

Neutron Imaging

RESEARCH ACTIVITY

- Research and development of new analysis techniques applied to cultural heritage based on neutron employment.
- Realization of innovative instrumentation for the identification of elemental mapping constituting the archaeological object through *Neutron Resonance Transmission* (NRT).

BELT MOUNT CONTAINING IRON, SILVER AND GLAZING COMING FROM HUNGARIAN NATIONAL MUSEUM INSTALLED ON OWN SUPPORT FOR MEASUMENTS AT ISIS (GB)

RESEARCH GROUP

Dipartimento di Fisica – Università degli Studi di Milano -Bicocca

Giuseppe Gorini
Enrico Perelli Cippo
Roberta Cattaneo
Giulia Festa

VIRTUAL CUT OBTAINED THROUGH NEUTRON TOMOGRAPHY OF ETRUSCAN VASE (*ARYBALLOS*)

RESULTS/PRODUCTS

- Bi-dimentional maps of elements inside cultural heritage objects.
- Virtual objects realization (video, images) for the neutron tomographic data presentation.

APPLICATIONS

- Bronze findings of archaeological site Guardamonte - Monte Vallassa
- Jewels (VII sec. A. C.) of Hungarian National Museum (Budapest)
- Ancient vase *aryballos* from Museo delle Civiche Raccolte Archeologiche di Milano
- Lombardic bronze belt mounts Museo delle Civiche Raccolte Archeologiche di Milano

CoIRICH

Neutron investigations

TIME-OF-FLIGHT NEUTRON DIFFRACTION (ND)

Crystal structure analysis, composition extimation of metallic alloys in non-destructive manner.

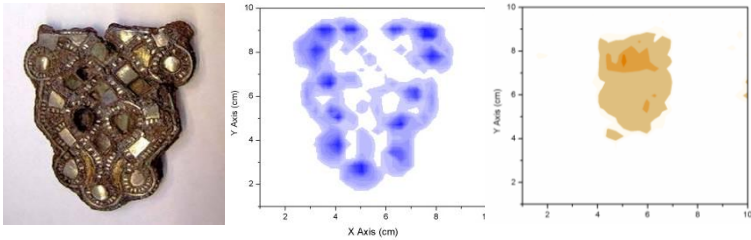
NON-DESTRUCTIVE ELEMENTAL ANALYSIS OF FINDINGS

NEUTRON RESONANCE TRANSMISSION (NRT)

Identification and mapping of elements constituting the archaeological finding.

BRONZE FIBULA (V SEC. B.C.) FROM PRE-ROMAN ARCHAEOLOGICAL SITE OF GUARDAMONTE

BELT MOUNT CONTAINING IRON, SILVER AND GLAZING COMING FROM HUNGARIAN NATIONAL MUSEUM INSTALLED ON OWN SUPPORT FOR MEASUMENTS AT ISIS (GB)



BELT MOUNT (VII SEC.) FROM HUNGARIAN NATIONAL MUSEUM: ON THE LEFT THE PICTURE OF THE OBJECT, IN THE MIDDLE THE SILVER MAPPING AND ON THE RIGHT THE COPPER MAPPING.

RESEARCH GROUP

Dipartimento di Fisica – Università degli Studi di Milano - Bicocca

Giuseppe Gorini
Enrico Perelli Cippo
Roberta Cattaneo
Giulia Festa

APPLICATIONS

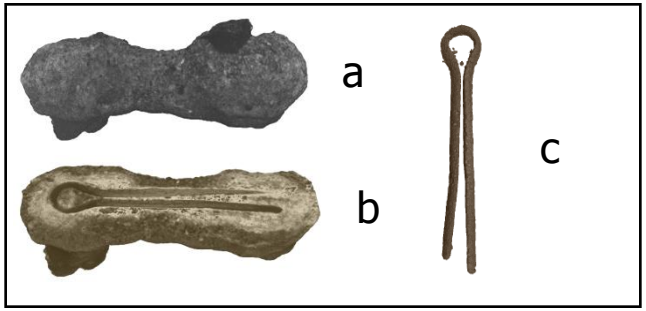
- Bronze findings of archaeological site Guardamonte - Monte Vallassa
- Jewels (VII sec. A. C.) of Hungarian National Museum (Budapest)
- Ancient vase *aryballos* from Museo delle Civiche Raccolte Archeologiche di Milano
- Lombardic bronze belt mounts Museo delle Civiche Raccolte Archeologiche di Milano

CoIRICH

Neutron investigations

RESEARCH ACTIVITY

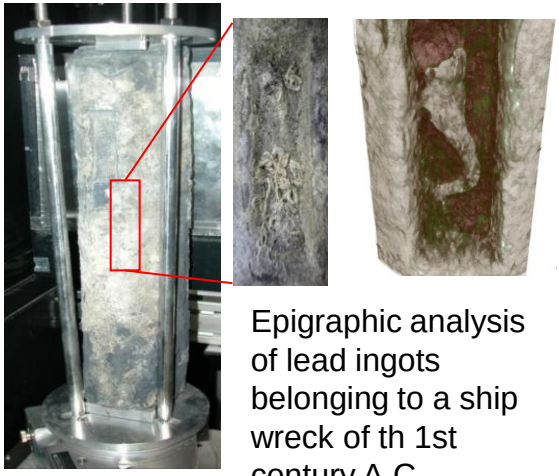
Neutron tomography allows the digital reconstruction (in a non destructive way) of the shape and the inner structure in samples which are covered by a thick layer of limescale as it is in ancient ship wreck.
One example is shown below. a) a picture of the sample, b) the inner digital reconstruction, c) the original object.



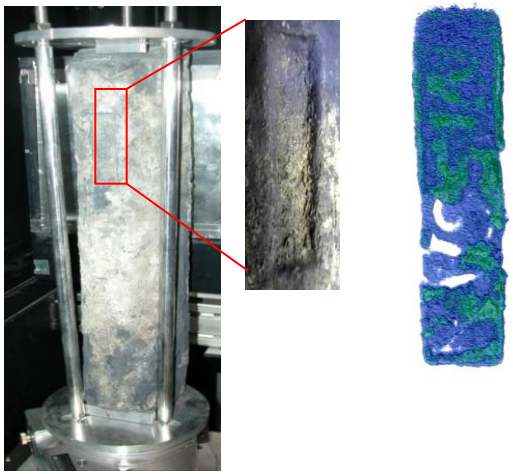
RESEARCH GROUP

Università degli Studi di Palermo with **Soprintendenza del Mare (Palermo)** and **HZB (Berlino)**
Fabrizio Lo Celso
Valerio Benfante
Philippe Tisseyre

Neutron techniques in the Cultural Heritage Field: Radiography and Tomography.



Epigraphic analysis of lead ingots belonging to a ship wreck of th 1st century A.C.



3D TOMOGRAPHIC RECOPNSTRUCTION OF A PORTION OF LEAD INGOT

EPIGRAPHIC ANALYSIS OF LEAD INGOTS

The combined use of the two techniques allows to obtain information on the inner structure of the lead ingots belonging to a roman ship wreck (1st century A.C.)

The epigraphic analysis is totally non invasive and it is very useful to rescue information about the producer and therefore the manufacture and the origin of the material for the ingots production. As example both the dolphin and the print "RUSSIN" indicates such a fact.

PERFORMED STUDIES

- Objects were recovered form roman ship wreck
- Epigraphic analysis of lead ingots of the 1st centure A.C.
- The samples belongs to the Sopraintendeza del Mare di Palermo and were investigated in collaboration with P. Thyssere.

CoIRICH

Neutron investigations

RESEARCH ACTIVITY

Analysis of the crystalline structure, texture and defects of the material. Such analysis combined with the SANS and USANS scattering techniques allows to inspect a spatial domain from the nanometer to the micrometer scale.

RADIOGRAPHY AND TOMOGRAPHY

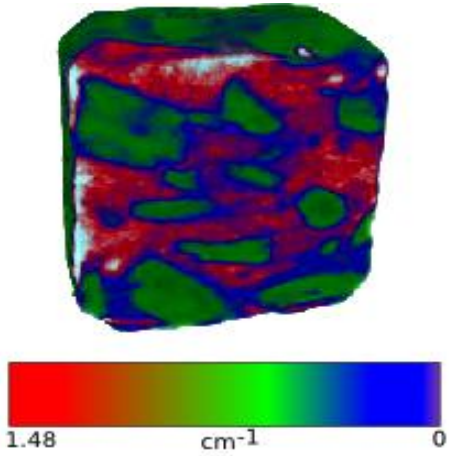
3D Tomographic reconstruction of the internal structure of a wide variety of materials

RESEARCH GROUP

Università degli Studi di Palermo
With **HZB (Berlino)**
Fabrizio Lo Celso
Valerio Benfante

NEUTRON TECHNIQUES IN THE CULTURAL HERITAGE FIELD: NEUTRON DIFFRACTION

VILLA ADRIANA IS THE SITE WHERE A SERIES OF WHITE AND POLYCHROME MARBLES HAVE BEEN SAMPLED AND INVESTIGATED BY THE DESCRIBED TECHNIQUES



3D TOMOGRAPHIC RECONSTRUCTION OF A VILLA ADRIANA MARBLE SAMPLE

SMALL ANGLE NEUTRON SCATTERING (SANS) AND ULTRA SMALL ANGLE NEUTRON SCATTERING (USANS)

The combined use of the two techniques allows to obtain structural information at the mesoscopic level for ine of the mosst common materials in the Cultural Heritage Field, the marbles.

PERFORMED STUDIES

- Fingerprinting of Marbles belonging to the Mediterranean Region
- Villa Adriana Marbles (Tivoli, Roma)
- Findings from Roman Ship Wrecks
- Epigraphic Analysis of Roman Lead Ingots (I A.C.)